MFR PAPER 1089

Results of Experimental and Exploratory Shark Fishing off Northeastern South America

L. J. K. KLEIJN

L. J. K. Kleijn's address is Oosterhoutlaan 6, Haarlem, Holland.

ABSTRACT—This paper describes the results of eight exploratory and experimental shark fishing cruises on the South American continental shelf off the Guianas. The types of gear used are described and an evaluation of the catches by gear, area, depth, season, species, length frequency, and length/weight correlation is given. The average catch per day for the area fished was roughly 3,000 pounds of dressed shark meat.

INTRODUCTION

During the second UNDP/FAO Caribbean Fishery Development Project Liaison Officers Meeting in September 1967 the participants were given a paper entitled "A proposal for harvesting sharks in the West Indian Area" (Rathjen 1967). The proposal was approved and a survey of shark availability was subsequently carried out during eight cruises conducted by the project vessel MV *Calamar* within the period December 1968 to August 1970. The area covered during the explorations was the north coast of South America from the border of Brazil in the east to the territorial waters of Trinidad in the west.

The purposes of the survey were: to obtain data about abundance and availability of sharks in the Guiana area; to evaluate shark fishing methods and teach local fishermen how to use them; and to provide the marketing section of the project with raw material for food processing and marketing demonstrations.

In 1945, an Anglo-American Caribbean Commission prepared a guide to commercial shark fishing in the Caribbean in which they described the species to be caught, how and where to fish, and which parts of sharks were useful, etc. (Anglo-American Caribbean Commission 1945.) This report was provided at a time when there was a major interest in shark fishing because the livers contain vitamin A which could not then be made synthetically. Since synthetic vitamin A can now be produced economically, the shark fishery has dropped off sharply. Prior to this synthetic vitamin A, shark fishing on a commercial scale was carried on from Barbados and Trinidad (Hsu, Kleijn, and Rathjen 1969).

Present shark fishing in the UNDP/FAO Caribbean Project region is of a limited nature. In the 1969 Statistical Yearbook of the United Nations the following figures are given:

Member countries of UNDP/FAO Project:

Trinidad and Tobago	1,100 metric tons
Martinique	100 metric tons
French Guiana	100 metric tons
Grenada	< 100 metric tons

Countries in the project area, but not members:

Cuba	2,600 metric tons
Venezuela	2,500 metric tons
Colombia	100 metric tons (probably most out of the Pacific Ocean)
Dominican Republic	< 100 metric tons

Besides these official figures it is known from local sources that small amounts of sharks (less than 100 metric tons annually) are landed in Surinam, Guyana, Barbados, and the Windward and Leeward Islands.

GEAR AND METHODS

Fishing Gear

During the exploratory fishing operation several types of gear were used. During the first four cruises steel cable setline, handline, the bottom longline, Cuban longline, and modified tuna longline were all tested experimentally. During subsequent cruises only the steel cable setline and handlines were used.

Steel cable setline (Fig. 1)

This gear consisted of a 3/8 inch diameter steel cable 3,000-5,000 feet in length. On this cable at 30-foot intervals, two 5/16 inch wire clamps were fastened about 6 inches apart. Between these two clamps, a 10 foot chain branch line with a Mustad[1] 2½-inch shark hook was attached with a snap fastener (Fig. 2). In total 100-175 hooks were used at a time. Figure 1 shows how the steel cable is operated during setting. The cable (D) which is stored on a drum of the trawl winch (A) is run over the fair leaders (B) to the rollers (C). A marker buoy (G) (Fig. 3) and a light buoy (H) are attached to the end of the line. The cable is then run out for a variable length depending on the depth. Next the anchor (F) is hooked to the line and this is followed by snapping on the individual baited hooks on chain leaders (E), then another anchor is snapped on and again a buoy and a light are attached to the end. Lights were used because the setline was generally soaked overnight. The line was soaked from 6 to 16 hours.

During cruise 70-7 an experiment was conducted in order to compare the catch from a full overnight set of the steel cable setline with two sets within about the same time period. Because only one steel cable setline was available the overnight set was followed the next night by two sets of about equal duration at the same depth and in the same general area.

Retrieving of the line is as follows: the buoys on one side are picked up and the end of the cable is attached to the drum of the winch and while retrieving the first anchor, hooks, second anchor, and buoys were consequently unsnapped (Fig. 4). When a big shark was brought alongside it was gaffed

[1] Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

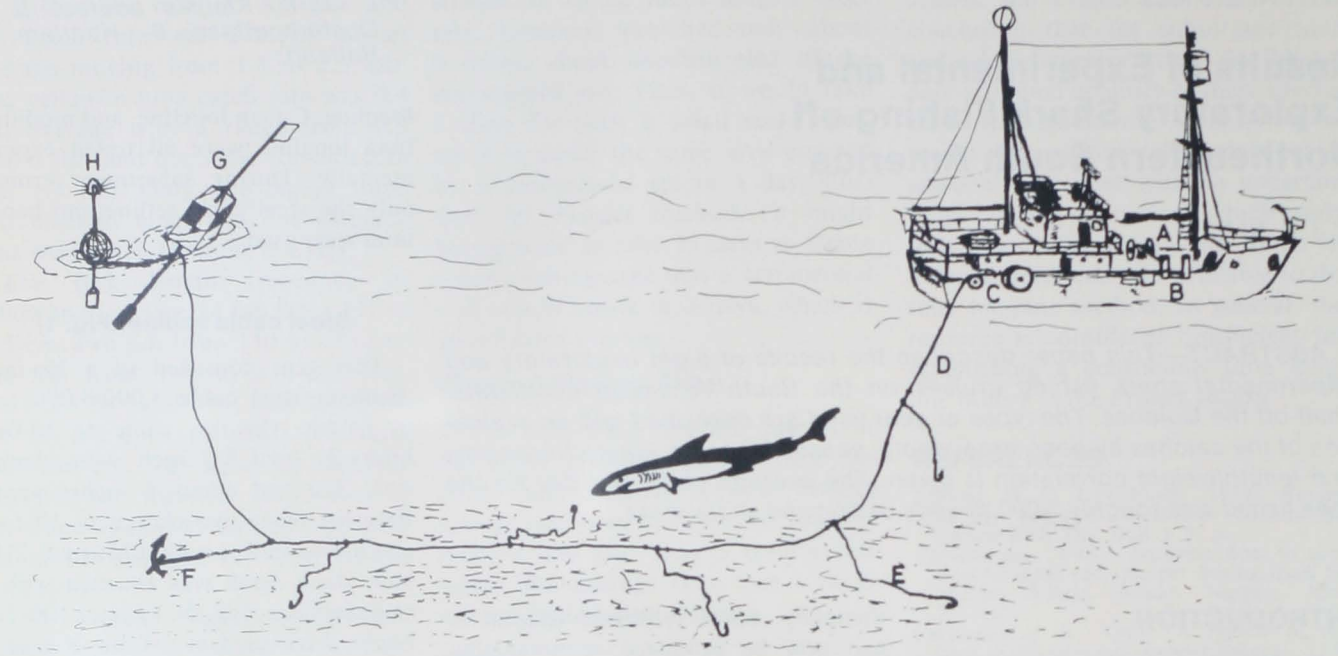


Figure 1.—Steel cable bottom setline gear used for shark fishing.

and then hoisted on deck with the help of a single wire whip attached to the mast.

Handline

A shark handline (Fig. 5) consisted of a coil of tuna longline rope (30 fathoms of ¼-inch tarred Kuralon rope) (A) with an 8-inch trawl float attached 2 to 3 feet from one end (B). At the same end a steel leader (C) (3 feet of ⅛-inch stranded stainless steel) with a tuna hook (D) (No. 38, Japanese measurement) is secured. One to eight individual lines were used during fishing operations. The handlining was conducted mostly after a bottom trawl haul, using a 40-foot shrimp trawl, as this often attracted sharks to the ship. Part of the crew sorted out the trawl catch while others threw out handlines from the drifting vessel. During the handlining operation scoops of trash fish were occasionally thrown overboard to attract the sharks. After the trawl catch was sorted, the entire crew alternated at handlining or gutting and dressing (Fig. 6) sharks already caught in order to keep the meat in prime condition.

Ten to 20 baskets of standard tuna longline (six hooks per basket) were anchored to the bottom and marked with buoys and lights as with the steel cable setline. A basket of longline was composed of seven mainline sections each 30 fathoms long and the hooks were attached to the end of 11½-fathom-long branchlines. Bottom longlines were usually fished with the steel cable setline at the same station for comparison.

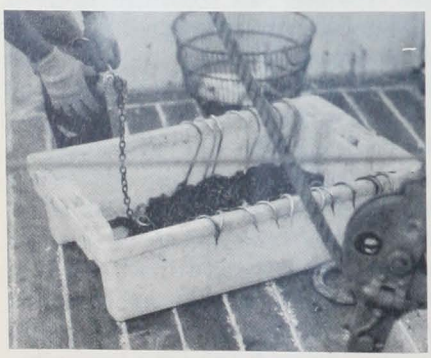


Figure 2.—A chain branch line with shark hooks attached.

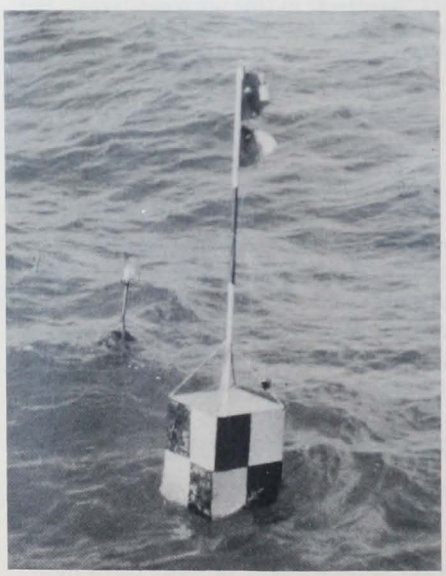


Figure 3.—Marker buoy and light buoy.

Figure 4.—Retrieving the steel cable setline.

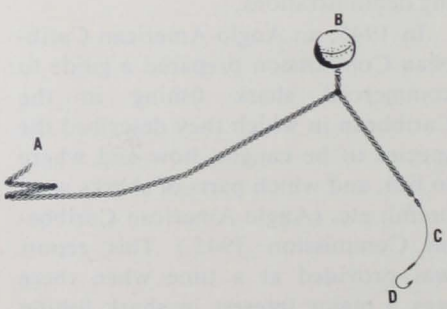


Figure 5.—Handline gear used for shark fishing.

Modified tuna longline

From 23 to 35 baskets of tuna longline, same construction as bottom longline, were used with a float at the end of each basket (float lines 12 fathoms long) and lights were used to mark the ends of the total line. These drifting sets were conducted on the edge of the continental shelf in deep water.

Cuban shark longline

The Cuban shark longline is a drift longline modified for shallow water use. It consists of 20 baskets with four hooks each. Normal drift longline is 23½ fathoms measured from the top float to the deepest point (hook) in a straight line, while the Cuban longline is only 11 fathoms and the mainline does not sag so much because of an extra float in the middle of the basket.

Bait Used

Bait used was mainly fresh fish caught by periodic trawling. On the steel cable setline, sea trout, *Cynoscion viriscens*, croaker, *Micropogon furnieri*, large whiting, *Macrodon ancylodon*, silverperch, *Larimus breviceps*, catfish, *Arius* sp. and *Bagre* sp., sharks, and other fish were used. Smaller fish, trash fish, and shark refuse when available, was chummed over the line while setting. Small sharks that took the baited hooks often became involuntary bait for bigger sharks and occasionally even these bigger sharks were mutilated by even larger ones. During handlining the smaller whiting and other fishes were used as bait, while trash fish was chummed overboard to attract the sharks to the boat.

Figure 6.—Gutting and dressing the sharks.

Processing On Board

When a shark was landed it was first stunned by sharp blows on the nose with a mallet. The tail was immediately cut off (Fig. 7) in order to bleed the shark while it was still fresh and the heart still beating. This was done to lower the urea level in the body and so reduce the possibility of urea contaminating the meat. When there was no time to process them immediately, they were stored in the shade and kept moist in order not to let the skin dry (Fig. 8). Further processing consisted of cutting off the head and fins and removing the viscera. After this they were very thoroughly washed (Fig. 9), rinsed, and put on ice in the hold. Fins, when large enough, were washed thoroughly with sea water and air dried. The remainder was normally thrown overboard. Many of these remaining parts could still have been used—for example: livers for oil, teeth and jaws for curios, and hides for leather.

Biological Sampling Methods

All sharks caught were identified to species using Bigelow and Schroeder (1948) and Casey (1964) as reference books. When a shark was caught and landed it was measured for total length (tip of snout to tip of upper lobe of caudal fin), classified by sex, and sometimes weighed (after dressing the meat). Beside this information other data such as sexual maturity, number of embryos, state of maturity, stomach contents, etc., were usually noted.

Figure 7.—Cutting off the shark's tail to bleed the shark.

Figure 8.—Sharks stored in the shade for later processing.

EFFORT AND AREA

Effort

The project vessel MV *Calamar* was used during eight cruises for shark exploration work (Table 1). The catch of the first trip was landed in Barbados. During the next three cruises the catch was landed in Port of Spain, Trinidad, partly for marketing purposes and partly for an experi-

Figure 9.—Sharks being washed and rinsed prior to being placed in the ship's hold.

mental food processing project. The catch of the last four cruises was landed mainly in Paramaribo, Surinam for food processing purposes.

Area

The geographic area covered during this exploration was the continental shelf off northeast South America from the Brazil-French Guiana border, northwest to and including the territorial waters of Trinidad (Fig. 10). The area is divided into 30-minute grids according to the longitude and latitude and numbered as shown. This is the area with a good trawl fish potential (Rathjen, Yesaki, and Hsu 1969). It is a regular and muddy continental shelf with many rivers from the South American continent flowing into it.

RESULTS AND COMMENTS

Fishing Operations

Catch by type of gear

The catch figures throughout are presented in pounds of finished dressed shark carcasses unless otherwise specified. This represents about 60 percent of the round weight. The catch rate by gear type is given in Table 2. It gives the catch rates observed for the different types of gear used on all exploratory, experimental, and simulated production fishing.

Table 1.—RV *Calamar* shark exploration cruises.

Cruise no.	Leave Barbados	Return to Barbados	Actual fishing days	Purpose of trip
68-13	3-Dec.-68	14-Dec.-68	8	Explor., experimentation & limited production
69- 1	8-Jan.-69	4-Feb.-69	18	Explor., experimentation & limited production
69- 2	17-Feb.-69	7-Mar.-69	11	Explor., & experimentation
69- 3	17-Mar.-69	1-Apr.-69	9	Explor., & limited production
69-10	9-Sept.-69	24-Sept.-69	31	Explor., & limited production
69-11	10-Nov.-69	17-Dec.-69	23	Explor., & limited production
70- 1	7-Jan.-70	28-Jan.-70	9	Exploration
70- 7	23-June-70	17-July-70	21	Experimentation

The catch per unit of effort was the highest with handlining, but this is biased because handlining (active fishing) at any location ceased soon after it was proved that there were no sharks available. Once the cable setline or any of the remaining methods (passive fishing) was set, however, effort continued without knowing whether or not there were sharks in the immediate vicinity.

The different types of longline were used only during the first three cruises. Thereafter they were abandoned because of low catch rates and because the work involved in longlining is more hazardous to personnel since the possibility of a big shark, or strong current, entangling the longline, is much greater than with the steel cable. Another disadvantage of the drift longline is that it is done in deep water, where bait trawling is not as productive as in shallow water, and is more time consuming.

A steel cable fishing experiment consisting of two periods of fishing overnight compared with the usual one overnight soak was conducted north of Paramaribo lightship, off Surinam, at six different depth intervals. This area was chosen as it proved to be a consistently good productive area during previous cruises and was close to the processing plant in Paramaribo. The results are shown in Table 3.

On an average basis the total of two sets per night provided a catch rate improvement of over 30 percent on an hourly basis and about 50 percent over an entire night's fishing. However, there is obviously more working time involved in making two sets than in a single set; i.e., 2 more hours soaking time plus 1½ hours for retrieving and resetting.

Catch by area

The area covered during shark fishing explorations is virtually the entire continental shelf north of the Guianas of northeastern South America (see Fig. 10). Many rivers flow into the Atlantic in this area. The total area has been arbitrarily divided first by country and second by river outlets per 1° of longitude. The following areas are recognized:

Country	River	Long. and Grid
French Guiana	Oyapock	51° to 52°W (T-39 + U-39)
	Cayenne	52° to 53°W (T-38)
	Iracoube	53° to 54°W (T-37 + S-37)
Surinam	Maroni	54° to 55°W (S-36 + R-36)
	Surinam	55° to 56°W (S-35 + R-35)
	Coppename	56° to 57°W (S-33 + R-34)
Guyane	Coreyyn	57° to 58°W (S-33 + R-33)
	Essequibo	58° to 59°W (R-32 + Q-32)
	Waini	59° to 60°W (Q-31 + R-31)
Venezuela	Orinoco	60° to 62°W (P-30 + O-29)

In Table 4 and Figure 11 the results of the catch per area are given for handlining and steel cable setlines. The best results for handline and steel cable combined were obtained in the Iracoube area of French Guiana. Other good handlining areas were Coppename and Cayenne rivers. The Surinam River area proved to be a consistently good steel cable setline area.

Table 2.—Catch rate by gear type.

Type of gear	No. of sets	No. of hr	Catch in lb	Lb/set	Lb/hr
Handline	—	245½	53,673	—	218.6
Steel cable setline	105	1,212	56,223	535.4	46.4
Bottom longline	13	178	2,042	157.0	11.5
Drift longline	4	47½	1,050	262.5	22.1
Cuban longline	1	4	15	15.0	3.8

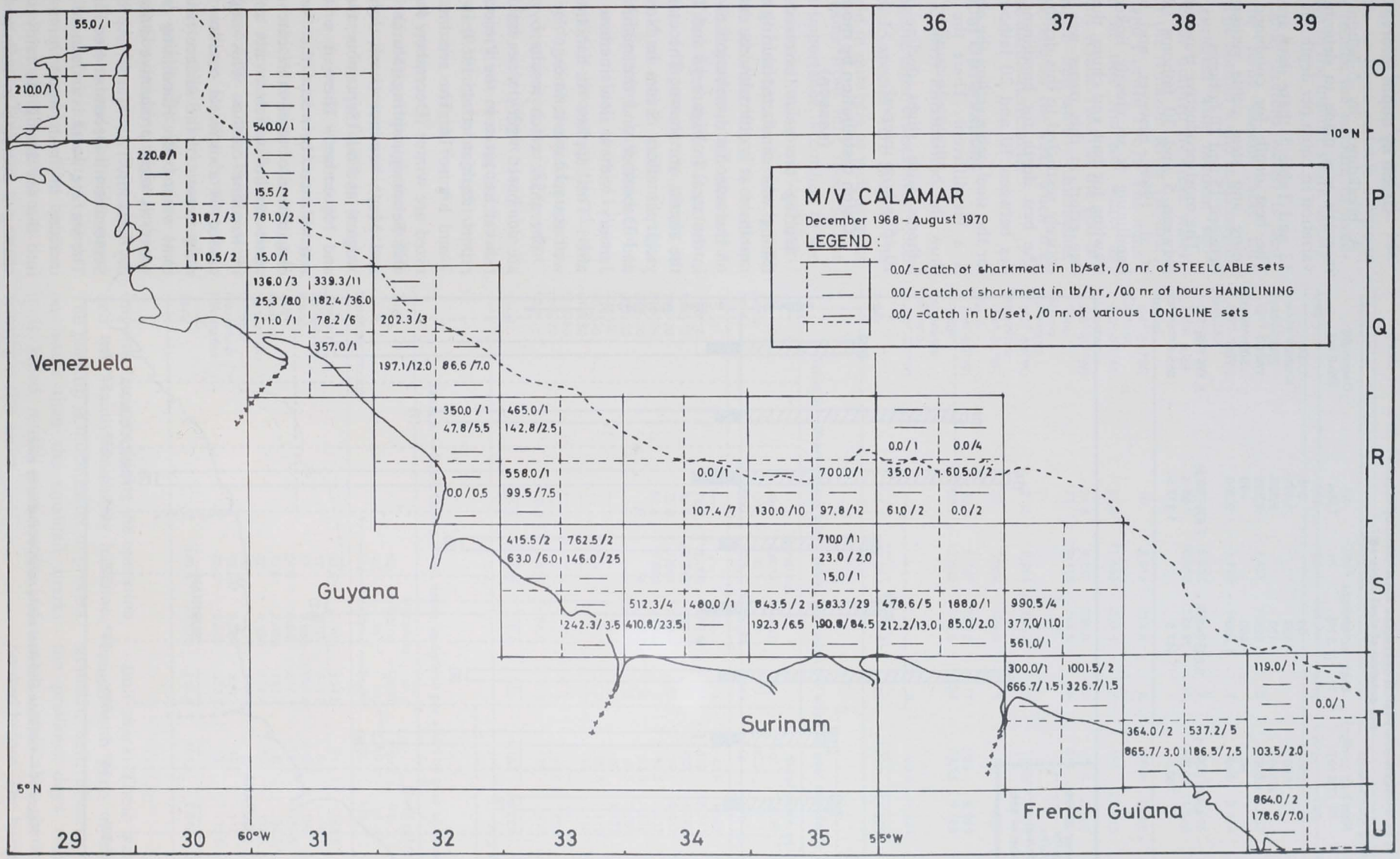


Figure 10.—Area covered during Project shark fishing explorations.

Table 3.—Pounds of dressed shark taken by depth and duration of steel cable set.

Depth (fms)	First half of night (7.8 hr)	Last half of night (7.3 hr)	Total	Overnight (13.0 hr)
5	250	60	310	1,000
10	550	520	1,070	700
15	2,050	470	2,520	250
20	1,000	525	1,525	1,900
25	80	400	480	505
30	750	1,250	2,000	780
Total	4,680 (47 hr)	3,225 (43.5)	7,905 (90.5)	5,135 (78)
Catch lb/hr	99.6	74.1	87.3	65.8
Catch lb/set	780.0	537.5	1,317.5	855.8

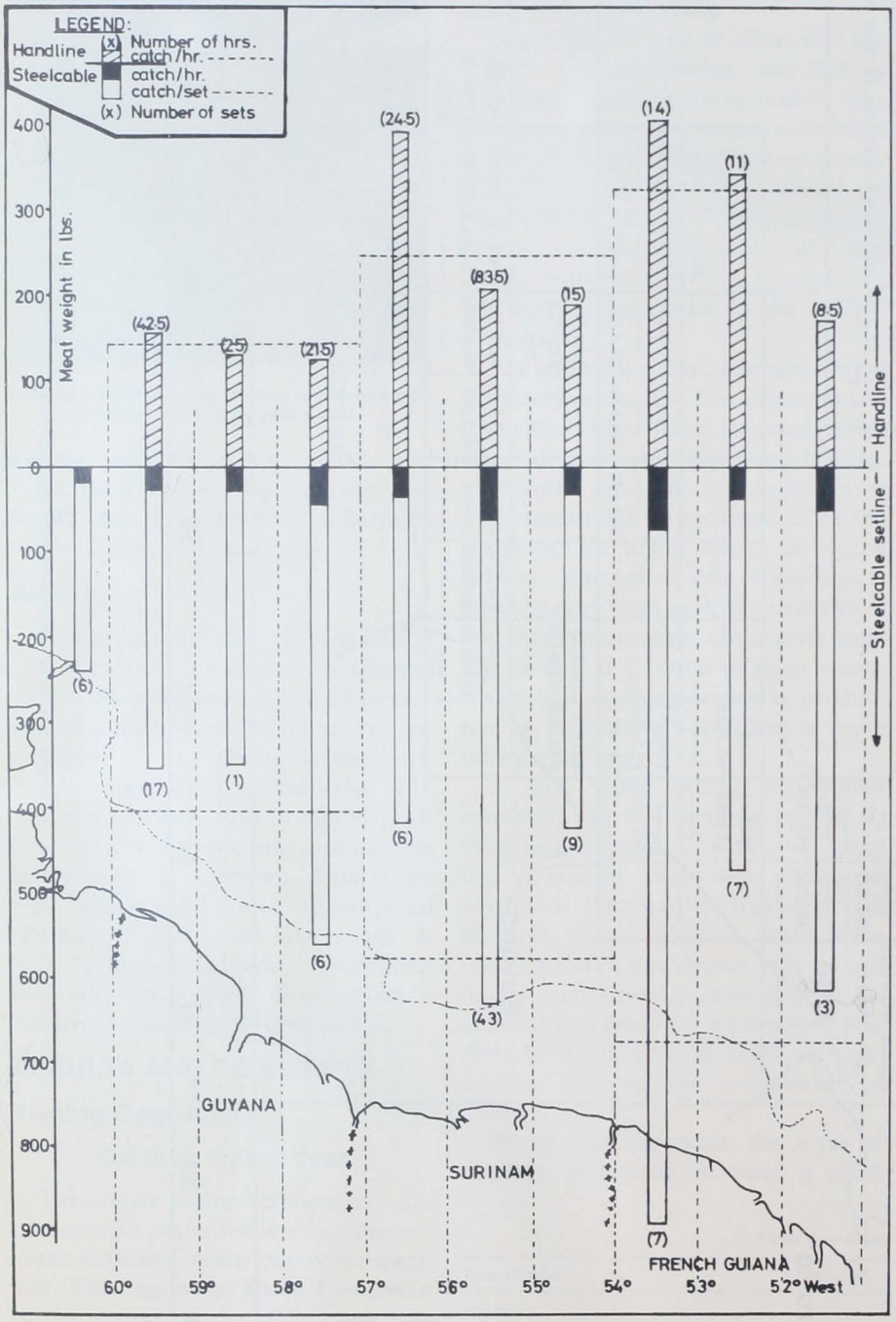


Figure 11.—Handline and steel cable catch of sharks by area.

Catch by depth interval

A breakdown by 5-fathom depth intervals was made to determine the variation in catch per depth. In Figure 12 and Table 5 these data are given. The best depth for combined handlining and steel cable setlining lies between 15 and 20 fathoms.

The most productive trawl area lies between 5 and 30 fathoms (Rathjen et al. 1969), however, and because handlining is so closely linked with trawling for bait and chum, the handline effort in this paper was almost entirely restricted to this depth range. The best depth for handlining alone lies between 10 and 20 fathoms, but for the steel cable setline the situation is a bit different. There the results show the best catches from 5 to 45 fathoms with slight decline at the 10-15 fathom interval.

Catch distribution by month (season)

During the years involved shark fishing was conducted during only 9 months so it is difficult to be definitive on the seasonal distribution of sharks in the area. In Figure 13 and Table 6 the results are shown. The maximum yield per effort occurs in November and December and the minimum in January with a slow increase thereafter. This applies to handlining as well as steel cable setlines.

The shark catch results by season are compared with the seasonal trawl fish catches given in the Project trawl report (Rathjen et al. 1969) in Table 7 and Figure 14. The seasons recognized are winter (December, January, and February), spring (March, April, and May), summer (June, July, and August) and fall (September, October, and November). There is a striking resemblance between the seasonal distribution of steel cable catches and trawl catches which is not reflected in handline catches. This might be caused by a different reaction to the rainy season of the surface (and bottom) water body. Handlining (surface water) is most productive during the dry seasons, i.e., March, April, and September till December (see Fig. 15). The surface water is influenced by an increase in fresh water running off into the sea during the rainy season, causing a decrease in salinity which

could force much marine pelagic life to migrate to more suitable environs and thus reduce the amount of available forage in the inshore shark fishing areas.

Steel cable (bottom water) is best during the rainy season, May till August. The bottom water mass might become enriched with nutrient subsurface water untilted by fresh water masses of the Amazon River (Ryther, Menzel, and Corwin 1967). The main influence of this Amazon water is during July (Gade 1961) at the end of rainy season and slowly diminishes till at the end of the year when the effects are hardly detectable.

Biological Observations

Species caught

During the eight cruises over 4,600 sharks of 25 species were caught. The main yield in numbers as well as meat weight came from four species. The order of importance, according to the numbers, is smalltail shark 44.2 percent, small blacktip shark (which will henceforth be referred to as blacktip shark) 42.9 percent, bull shark 3.8 percent, and tiger shark 3.0 percent. The order of importance by weight is blacktip shark 41.2 percent, tiger shark 15.1 percent, bull shark 14.4 percent, and smalltail shark 11.9 percent. Over 93 percent of the sharks caught belonged to these four species and they contributed over 82 percent of the total meat weight. In Table 8 the catch is given in a species breakdown by sex, method of capture, depth range, and the weight for the most important species.

Smalltail shark. Although the smalltail shark is the most abundant species by number it is only fourth in weight yield. The majority were caught on the handline. These sharks are tough animals which continue to struggle long after they are caught. Dressing them is not easy as they have a well ossified cartilage. Results showing that the smallest smalltail sharks are caught by trawl and steel cable setline and the biggest by handline might perhaps indicate that the young animals live near the bottom and the older ones near the surface. Smalltail sharks caught on steel cable setline became bait and attracted still larger sharks.

Blacktip shark. This was the most important species during the operation and was mainly caught by handline. The blacktip is much easier to process on board than the smalltail shark; it is killed much more easily and dressing is also easier.

Bull shark. These were very often caught with parts of sharks in their stomach, bait, discarded refuse from the previous day's cleaning of the catch, and also sharks that were hooked before. The bull sharks caught

Table 4.—Shark fishing effort, catch, and catch per effort by gear and degree of longitude.

	Handline			Steel cable setline			
Area	No. of hrs.	Catch in lbs.	Catch in lbs./hr.	No. of sets	No. of hrs.	Catch in lbs.	Catch in lbs./set	Catch in lbs./hr.
French Guiana								
Oyapock (51°-52°W)	8.5	1,457	171.4	3	34.5	1,847	615.7	53.5
Cayenne (52°-53°W)	11	3,765	342.3	7	84.5	3,414	487.7	40.4
Iracoube (53°-54°W)	14	5,637	402.6	7	85	6,265	895.0	73.7
Total	33.5	10,859	324.2	17	204	11,526	678.0	56.5
Surinam								
Maroni (54°-55°W)	15	2,919	194.6	9	106.5	3,826	425.1	35.9
Surinam (55°-56°W)	83.5	17,483	209.4	43	439	27,113	630.5	61.8
Coppename (56°-57°W)	24.5	9,717	396.6	6	72.5	2,529	421.5	34.9
Total	123	30,119	244.9	58	618	33,468	577.0	54.2
Guyana								
Corentyne (57°-58°W)	21.5	2,694	125.3	6	73.5	3,379	563.2	46.0
Essequibo (58°-59°W)	25	3,234	129.4	1	12	350	350.0	29.2
Waini (59°-60°W)	42.5	6,767	159.2	17	235	6,059	356.4	25.8
Total	89	12,695	142.6	24	320.5	9,788	407.8	30.4
Venezuela								
Orinoco (60°-61°W)	—	—	—	6	69.5	1,441	240.2	20.7
Total	245.5	53,673	218.6	105	1,212	56,223	535.4	46.4

Table 5.—Shark fishing effort, catch, and catch per effort by gear and depth interval.

	Handline			Steel cable setline			
Depth (fms.)	No. of hrs.	Catch in lbs.	Catch in lbs./hr.	No. of sets	No. of hrs.	Catch in lbs.	Catch in lbs./set	Catch in lbs./hr.
-5	—	—	—	4	42.5	1,393	348.3	32.8
5.5-10	73.0	13,200	180.8	31	329	18,341	591.6	51.1
10.5-15	88.5	23,796	268.9	36	422	14,263	396.2	33.8
15.5-20	28.0	7,544	269.4	13	149	10,942	841.7	73.4
20.5-25	52.5	8,950	170.5	5	52.5	2,817	563.4	53.7
25.5-30	1.5	74	49.3	6	62.5	3,632	605.3	58.1
30.5-35	—	—	—	2	28.5	1,209	604.5	42.4
35.5-40	—	—	—	2	25	1,562	731.0	62.5
40.5-45	—	—	—	2	23.5	1,219	609.5	51.9
45.5-50	—	—	—	1	11	110	110.0	10.0
50.5-55	—	—	—	—	—	—	—	—
55.5-60	—	—	—	2	23.5	735	317.5	31.3
60+	2.0	109	54.5	1	13	0	0.0	0.0
Total	245.5	53,673	218.6	105	1,182	56,223	535.4	46.4

Table 6.— Shark fishing effort, catch, and catch per effort by gear and month.

	Handline			Steel cable setline			
Catch per month	No. of hrs.	Catch in lbs.	Catch in lbs./hr.	No. of sta.	No. of hrs.	Catch in lbs.	Catch in lbs./set
January	82.5	11,100	134.5	21	263.5	7,547	359.4
February	17	4,104	241.2	8	98	3,556	444.5
March	37	9,838	265.9	9	108	3,631	403.4
July	26.5	6,547	247.1	19	174.5	13,203	694.9
August	13.5	2,459	182.1	6	58.5	2,451	408.5
September	22	4,320	196.4	11	124.5	7,083	643.9
October	6	711	118.5	8	94.5	4,044	505.5
November	15.5	5,064	326.7	10	117	7,051	705.1
December	25.5	9,530	373.7	13	173.5	7,657	693.2
Total	245.5	53,673	218.6	105	1,212	56,223	535.4

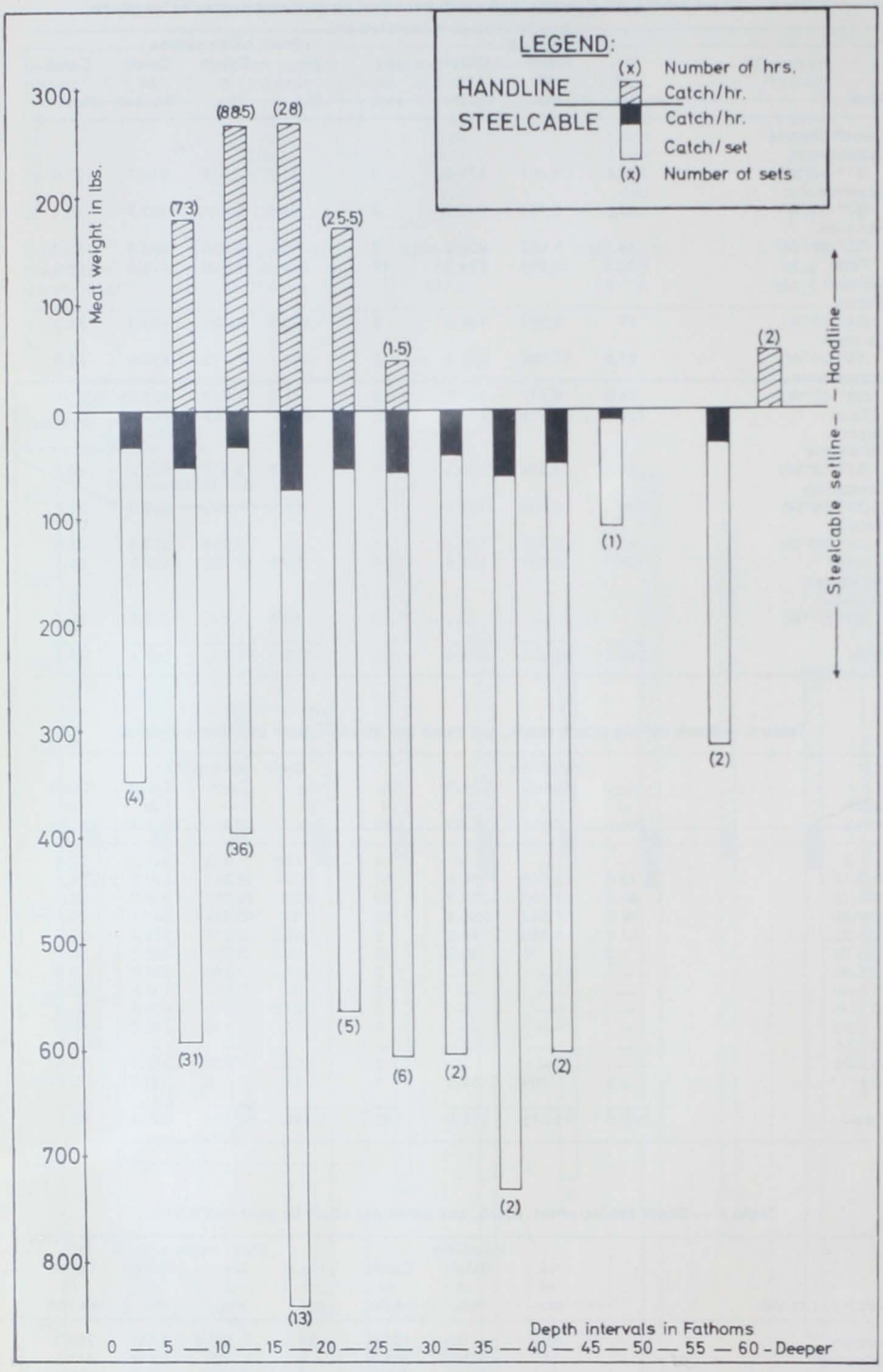


Figure 12.—Handline and steel cable catch of sharks by depth interval.

on setlines, including even the larger ones, were sometimes badly mutilated by other sharks.

Tiger shark. These were often still alive when caught on the steel cable setline; the contrary held true for the bull sharks. They often gave a heavy struggle before being decked. These sharks are easy to dress as they have a very soft cartilage. Their stomachs contain a large variety of items such as turtle, all kinds of fishes, birds, and sharks. These sharks are true scavengers.

Other sharks. The meat of nearly all the sharks caught was used for further processing on land except for the nurse shark whose meat deteriorated rapidly after being caught and was discarded.

Table 7.—Seasonal catch rates for shark handlining and steel cable setlines and bottom fish trawling.

Season	Handline Catch lb/hr	Handline Rank no.	Steel cable Catch lb/hr	Steel cable Rank no.	Total trawl by *Calamar* Catch lb/hr	Total trawl by *Calamar* Rank no.
Winter	198.7	(4)	35.1	(3)	665.7	(3)
Spring	265.9	(1)	33.6	(4)	608.0	(4)
Summer	225.3	(3)	67.2	(1)	986.5	(1)
Fall	232.1	(2)	54.1	(2)	769.7	(2)

Length frequency

Total length was measured on most of the sharks caught. As the total number of the majority of species caught was very small, only length frequency curves for the four major species were prepared (see Figs. 16, 17). These curves show that the females of the three carcharhinid species (smalltail, blacktip, and bull shark) develop to a larger size than the males (Table 9).

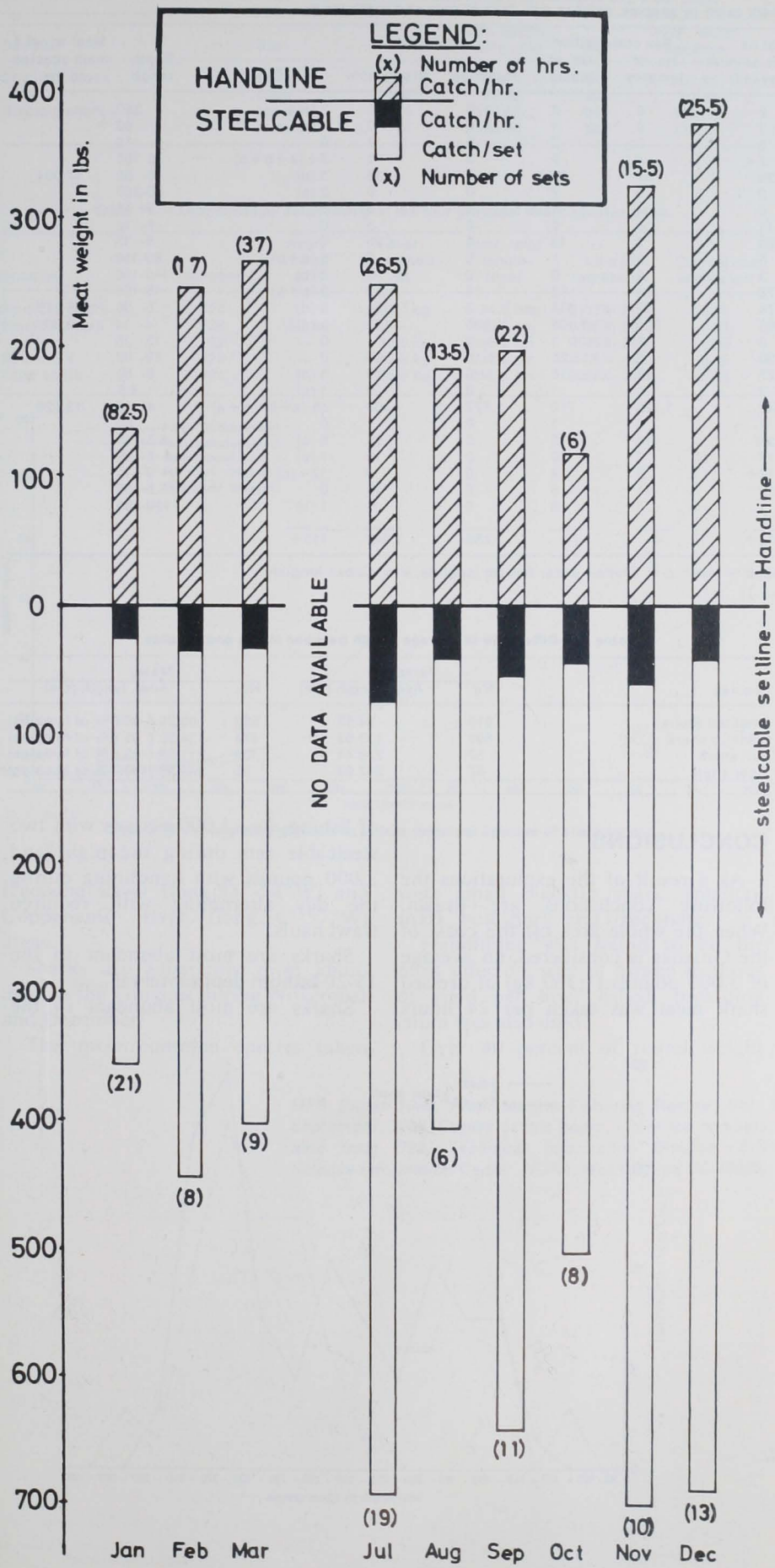
The tiger sharks have a much greater length range, but the number caught was relatively few, so the sex difference in average length is not considered significant.

From the two species most frequently caught by steel cable and handline (smalltail shark and blacktip shark), we can see from Table 10 that the smalltail shark caught by steel cable is smaller than those caught by handline. This is the reverse of the blacktip shark (Table 10).

Length/weight correlation

The total length of each weighed shark (in centimeters) was compared with its weight (in kilograms) to find the correlation between the two values (Table 11). The length/weight correlation is of importance as it is easy to measure the length of a shark, but not so easy to accurately weigh him on a ship at sea. In Figure 18 the length/weight regression lines of the four main species are shown for the relation between dressed weight and length. The blacktip shark is the only species where enough data are available to compare dressed weight and round weight to length. The weight of dressed blacktip sharks is approximately 60 percent of the round weight.

Figure 13.—Handline and steel cable catch sharks by month.



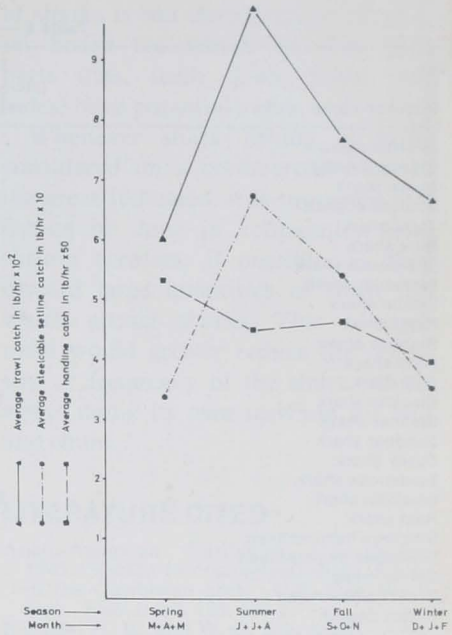


Figure 14.—Comparison of steel cable setline and handline catches with trawl catches per season as given in Rathjen et al. 1969.

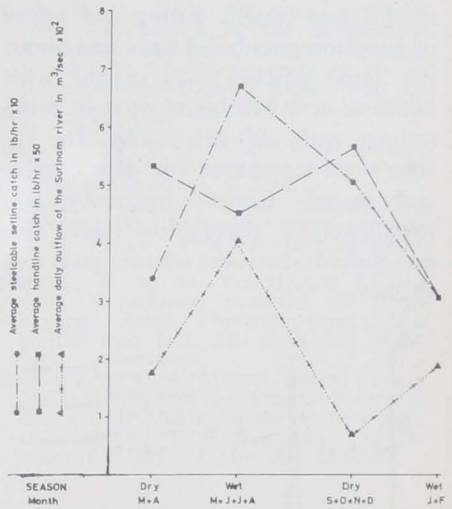


Figure 15.—Comparison of steel cable setline and handline catches with the average daily outflow of the Surinam River per rainy season.

SUMMARY

Shark fishing explorations were carried out by the UNDP/FAO Caribbean Fishery Development Project with the MV *Calamar* from December 1969 until August 1970.

Different fishing techniques were used, but emphasis was put on handlining and bottom (steel cable) setlining. The area covered is roughly the continental shelf of South America off the Guianas.

Over 4,600 sharks were caught of

Table 8.—Shark catch by species, number, sex, type of gear and depth range.

Common name	Total no. (includes animals not sexed)	Sex composition No. of females	No. of males	Gear type Handline	Steel cable	Other*	Depth range	Meat wt. of 4 main species in lbs.
Shortfin mako	2	0	2	0	0	2 (a)	350	
Bigeye thresher	1	0	1	0	0	1 (a)	80	
Nurse shark	2	0	2	0	2	0	19	
Smooth dogfish	7+	4	2	0	0	7+(a+b+c)	5-180	
Tiger shark	139	67	68	0	136	3 (d)	5- 60	17,034
Blue shark	2	0	2	0	0	2 (a)	80-360	
Sharpnose shark	5	4	1	2	3	0	9- 16	
Finetooth shark	11	5	6	8	3	0	6- 12	
Lemon shark	20	7	13	0	20	0	5- 15	
Night shark	5	3	1	0	0	5 (a+b)	80-190	
Bignose shark	3	2	0	0	0	3 (b)	140-190	
Silky shark	78	34	42	19	57	2 (a+b)	15-186	
Bull shark	174	55	114	2	164	8 (d)	5- 35	16,315
Blacktip shark	1,983	829	1,108	1,846	132	5 (d)	4- 34	46,603
Spinner shark	3	2	1	2	1	0	15- 26	
Sandbar shark	30	5	25	0	30	0	19- 60	
Dusky shark	27	11	16	0	26	1 (d)	6- 60	
Bladenose shark	1	0	1	0	0	1 (c)	8.5	
Smalltail shark	2,040	1,129	710	1,577	408	55 (a+b+c+e)	4- 40	13,528
Reef shark	1	0	1	0	1	0	60	
Smalleye hammerhead	31	18	12	0	25	6 (c)	5.5- 15	
Scalloped hammerhead	17	7	10	0	16	1 (a)	8- 45	
Bonnet head	12+	5	4	0	0	12+(c)	9- 15	
Great hammerhead	18	11	6	0	18	0	5.5- 35	
Cuban dogfish	1	1	8	0	0	1 (b)	120-180	
Total	4,613+	—	—	3,456	1,042	115+		

*A = drifting longline, b = deepwater bottom longline, c = trawl, d = shallow water bottom longline, e = Cuban longline.

25 species yielding over 110,000 pounds of dressed meat. Nearly half of this was caught during 245 hours of handlining with 1-8 lines and about the same amount was caught with 105 sets or 1,212 hours of steel cable setlines with 100-175 hooks. The results were compared for depth, area, and month. Length frequency and length/weight correlation was also established for the four principal species.

Table 9.—Difference in average length between males and females.

Species	Females No.	Aver. length (cm)	Males No.	Aver. length (cm)
Smalltail Shark	910	94.52	599	90.39 (95.6% of females)
Blacktip shark	699	139.99	974	134.20 (95.9% of females)
Bull shark	52	226.44	109	211.86 (93.6% of females)
Tiger shark	67	247.63	65	249.38 (100.7% of females)

CONCLUSIONS

As a result of the explorations the following conclusions are drawn. When the whole area off the coast of the Guianas is considered, an average of 3,000 pounds (1,360 kg) of dressed shark meat was taken per 24 hours of fishing, i.e., 1,000 pounds with two steelcable sets during the night and 2,000 pounds with handlining during the day alternating with required trawl hauls.

Sharks are most abundant in the 15-20 fathom depth interval.

Sharks are most abundant in the

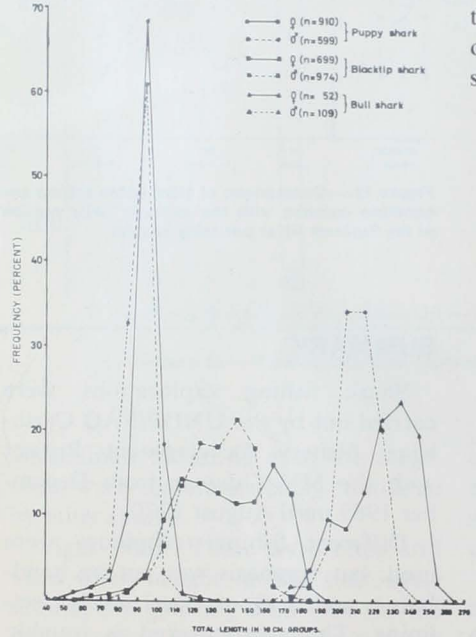


Figure 16.—Length frequencies observed in the catch of both sexes of three shark species.

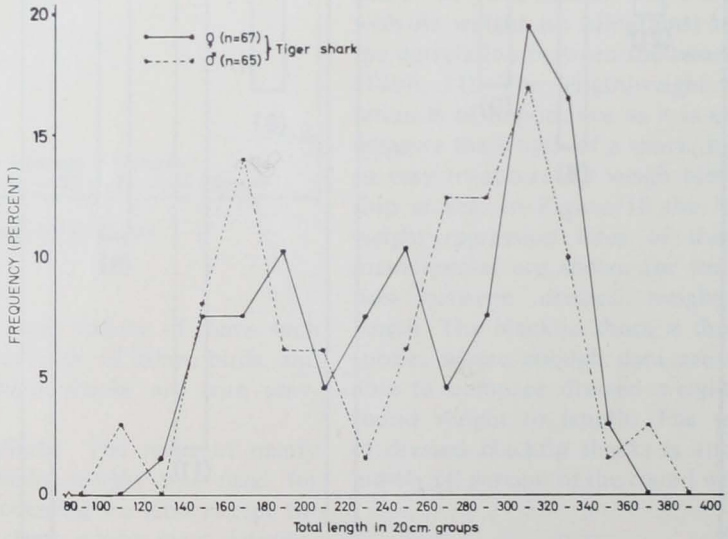


Table 10.—Difference in average length between sharks caught by handline and steel cable.

Species	Sex	No.	Aver. length Steel cable	No.	Aver. length Handline
Smalltail shark	female	269	92.73	644	95.55
	male	194	89.48	406	91.10
Blacktip shark	female	44	150.07	650	139.36
	male	74	143.76	880	136.23

Table 11.—Length/weight relationship of the four principal shark species taken.

Species	Number	Aver. round wt.	Aver. dressed wt.	Aver. total length (live)	Line of regression	Correlation coefficient
Smalltail shark	120	—	3.1 kg	94.6 cm	.0117X-.6030	0.87
Blacktip shark	238	18.3 kg	—	133.3 cm	.0100X-.0586	0.97
	129	—	12.5 kg	138.2 cm	.0095X-.2990	0.99
Bull shark	125	—	42.8 kg	216.5 cm	.0054X + .4421	0.98
Tiger shark	124	—	55.9 kg	252.5 cm	.0062X-.0056	0.98

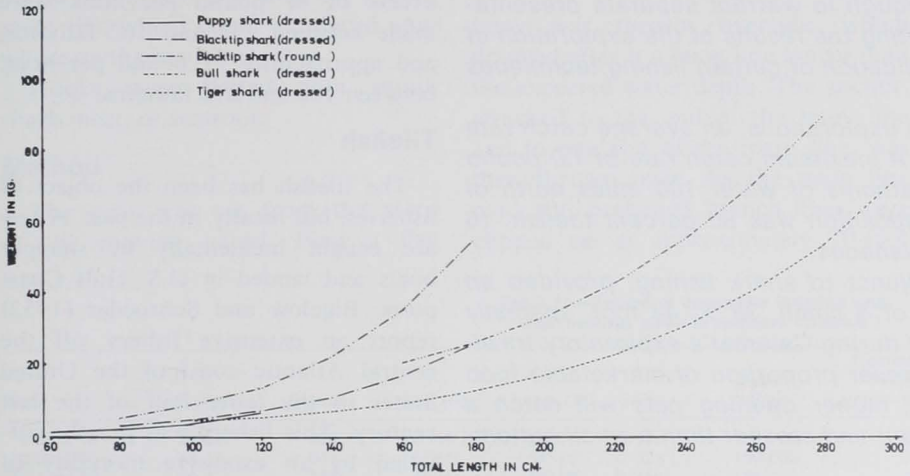


Figure 18.—Length/weight curves of four principal species of shark taken.

Iracoube River (long.53°-54°W) and Coppename River (long.56°-57°W) areas.

Sharks are apparently most abundant in the Guianas during November and December.

The most common species taken were small blacktip shark, smalltail shark, bull shark, and tiger shark.

Handlining was found to be the most effective way of fishing in terms of yield per hour fished, providing chum was also used.

Over 40 percent of round weight of sharks is lost during initial dressing on board the vessel. Of this some parts (fins, teeth, jaws, livers, and hides) have potential value.

Whenever shark fishing is being considered on a commercial basis in the areas indicated, it is suggested that fishing be done in cooperation with shrimp trawlers, if possible, as they discard large quantities of trash fish which attract sharks. This arrangement would greatly reduce the necessity or frequency of the shark fishing vessel doing its own trawling for bait and chum.

LITERATURE CITED

Anglo-American Caribbean Commission. 1945. Guide to commercial shark fishing in the Caribbean area. U.S. Fish Wildl. Serv., Fish. Leafl. 135, 149 p.

Bigelow, H. B., and W. C. Schroeder. 1948. Sharks *In* H. B. Bigelow (editor), Fishes of the western North Atlantic. 1(1):59-546. Mem. Sears Found. Mar. Res., Yale Univ., New Haven.

Casey, J. G. 1964. Anglers' guide to sharks of the northeastern United States Maine to Chesapeake Bay. U.S. Bur. Sport Fish. Wildl. Circ. 179, 32 p.

Gade, H. G. 1961. On some oceanographic observations in the Southeastern Caribbean Sea and adjacent Atlantic Ocean with special reference to the influence of the Orinoco River. Boll. del Inst., Oceanographic de la Univ. de Oriente 1(2):289-342.

Hsu, B. C., L. J. Kleijn, and W. F. Rathjen. 1969 (Unpublished.) Experimental shark fishing off the Guianas.

Rathjen, W. F. 1967. (Unpublished) UNDP/FAO Caribbean Fishery Development Project Proposal for harvesting sharks in the West Indian Area.

Rathjen, W. F., M. Yesaki, and B. Hsu. 1969. Trawlfishing potential off northeastern South America. Proc. Gulf Caribb. Fish. Inst., 21st annu. sess., p. 86-110.

Ryther, J. H., D. W. Menzel, and N. Corwin. 1967. Influence of the Amazon River outflow on the ecology of the western tropical Atlantic. I. Hydrography and nutrient chemistry. J. Mar. Res. 25:69-83.

MFR Paper 1089. From Marine Fisheries Review, *Vol. 36, No. 9, September, 1974. Copies of this paper, in limited numbers, are available from D83, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235.*